Communications Apparatus And Method

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This invention relates to communications apparatus and a method. It
particularly relates to apparatus including a router and a method involving
a router using a point to point protocol.

10   Routers are used to interconnect networks and the Internet, for example,
is made up of a plurality of networks interconnected by routers. A local
area network of interconnected computers in a department may be
connected by a router to other local area networks serving other
departments in an organisation and also to external networks and the
15   Internet.

A communication is directed by the router by using an Internet Protocol
IP address allocated to a particular terminal on the network. It will be
appreciated that there are only a limited although large number of
20   possible addresses. In order to cater for the large number of terminals
there are global IP addresses for networks and local IP addresses for the
terminals. The global addresses are allocated by Internet service
providers coordinating with the Internet Assigned Number Authority and
the local IP addresses provided from a scheme set up and maintained by
25   the controller of the LAN. In order to route a communication for a
terminal on a LAN served by the router, address translation tables are
provided to translate from a global IP address to a local address. The
advantage of this translation process is that it is relatively straightforward
to add new terminals to the LAN or to make other changes requiring an

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update to the address. The translation process is referred to as Network Address Translation (NAT) and it is usually carried out by a software entity within the router.

5   By using the NAT technique the global addresse are dynamically allocated to a connection. When the communication is finished the address is freed for use by another connection. A further software entity within the router called a connection controller monitors the traffic and if a connection is not used for a particular length of time the connection is

10   timed-out and broken and the address freed for re-allocation when required. The approach adopted is a simple one in which traffic on the link is used to indicate that the link is in use. That traffic however may include packets that are unwanted by a terminal on the LAN and will not be answered when passed to the LAN by the router. For example, a

15   terminal user may have been engaged in browsing the Internet and then discontinued using the browsing application program. Internet frames may still be being delivered which are unwanted. This traffic on the link will result in the connection controller maintaining the connection. Accordingly, this so-called "short-hold" process may lead to an address

20   being held which could be usefully re-allocated.

According to the invention there is provided communications apparatus comprising a router and a connection controller which router, in use, routing data to and from terminals on a local area network and the

25   connection controller controlling connections involving at least one of the terminals, a network address translation translator for translating addresses on incoming data to addresses of terminals on the network; a monitor for monitoring the usage of a network addresses and for sending a message indicative of non-usage to the connection controller; the

connection controller being responsive to the receipt of the message to
determine whether to release the connection.

By sending a message to the connection controller when an address is
unused the connection will be cleared even when a short-hold process
would otherwise be implemented and the link apparently being used by
packets arriving at the router which are unwanted.

By releasing the connection sooner than would otherwise be the case
connection costs will be reduced. A yet further benefit is that the security
of the network is enhanced.

The invention may be used to break more than one PPP-connection. In
some arrangements the router may be used to provide connections to
more than PPP interface and more than one LAN. The invention allows
the use of connection controllers embodied as software objects each
controlling a particular PPP connection and each may be made responsive
to a message to release the connection.

The invention also provides a method.

A specific embodiment of the invention will now be described with
reference to the drawing in which:

Figure 1 shows a local area network of computer terminals connected by
a router operating in accordance with the invention to the Internet; and

Figure 2 shows the router and network of figure 1 in greater detail.

As is shown in figure 1, a local area network LAN 1 is formed of a number of computer terminals 2 to 7 linked by an Ethernet 8. The LAN 1 is connected to the Internet 9 by a router 10. The connections to the terminals 2 to 7 and the Internet are controlled by a software entity within

5   the router 10 called a connection controller 11. The router 10 also includes a network address translation (NAT) translator 12 (sometimes referred to as a NAT box) which hold translation tables in memory (not shown) and an IP router 13.

10   Whilst in this embodiment the router 10 is connected to one LAN respective PPP-interface it will be appreciated that it may serve more than one LAN or more than one PPP-interface. (Each PPP-interface may have its own individual connection controller)

15   The router 10 is connected to a modem 14 and thence via an internet service provider 15 to the Internet 9. The link to the modem 14 is a digital subscriber line (DSL) operating in accordance with a point to point protocol (PPP) and a point to point protocol over Ethernet (PPPoE). (The link may in alternative embodiments be an Integrated Digital Services

20   Network (ISDN) line and in general involve the use of other protocols).

The LAN 1 operates in accordance with Ethernet standard IEEE 802.3. The connection control establishes a connection between a terminal on the LAN 1 and the Internet service provider 15 to permit Internet

25   browsing by an application program running on the terminal or to allow emails to be sent and received. It will be understood that each terminal may have more than one application utilising the connection at any given time. Each application will utilise a logical port. For example, terminal 2 may be running an Internet browser and an email application. The

browser application will be served via a first logical port and the email
application served by a second logical port.

5   With the connection made, information in the form of datagrams
compatible with TCP/IP protocol flow between the Internet 9 and the
ports.

Figure 2 shows the modem 14, router 10 and LAN 1 in more detail.
The network address translator 12 allocates to an application an address
10   to be used for the purpose of the connection. As is shown in figure 2, the
terminals have an IP address of the form IPi, IPj and IPk. Each
application running on the terminal will require a port. In the figure, the
terminals are shown with just one port having an identifier Portl, Portm
and Portn. The terminal address IPi, IPj or IPk is an internal LAN
15   address set up in accordance with an addressing scheme supported by the
LAN operator. Both the IP address and the port addresses are stored in a
memory structure within the translator 12 called a Network Address
Translation Table (NAT). The table has two fields 16 and 17 which
contain the global address information. This is of the form IP_g $Port_{g1to3}$
20   where g denotes global. The local IP addresses and port numbers are
written into the rows of field 17(and in some applications in other fields).
The global session IP address and the corresponding global port numbers
are written in the corresponding division of the address field 16.

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When the connection is established, the internet sender communicating
with the terminal 2 utilises an IP address IP_g included in the arriving
packets. This is the address that will be used for the rest of the

connection and is therefore called the session IP address. In the examples given this address will be converted into a local IP address and terminate in 1, 2 or 3. Thus for a datagram to arrive from the Internet at the router 10 for forwarding to an application on a terminal it will include the router

5   address for example 100.1.1.5 and a specific port number which is utilized by the router to address a specific local terminal and the corresponding application. The network address translator responds to the global IP/Port address to return the appropriate local IP and port address from field 17 and the IP router 13 sends the data onto the LAN 1 with an

10   appropriate header. Note, that the correct conversion from global to local addresses can be done by the router as the communication is always initiated from the local LAN, so the router stores that initial local addresses and converts these to global addresses, all having the same IP_g but different Port addresses. When the packets return with the global

15   address information, the router can reassign the original local values

The terminals 2 to 7 may be located on one departmental LAN. This grouping may be served by one interface on the router which connects the group to the Internet. The usage of the connection of the group as a

20   whole on this interface will be monitored by the IP router 13. IP packets arriving and leaving the LAN by the interface indicate that the connection is still required.

A further entry in the NAT table 12 is provided to record the time at

25   which the IP router 13 determines that a specific row of tables 16 and 17 has been used for the last time. These are the entries z_x to z_z in the field 17.   When the difference between this time and a current time determined by reference to an internal clock exceeds a threshold, the entry (row) is marked as "unused" in the unused flag u_x to u_z. If all of the

rows in the table are unused then the connection controller 11 will be
instructed to clear the connection. (This connection being a DSL or ISDN
connection.) The table is checked by the IP router 13 in cycles and
updated. . In essence, if we consider the period of checking the NAT

5   table entries as a monitoring period Tc then , n the number of cycles may
be derived from the short hold time Ts as follows to mark an entry as
unused:

$n = integer(Ts/Tc) + 1.$

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A NAT entry that has been unused for n cycles is marked as "unused" but
not deleted although the connection may already have been broken by the
connection controller. It will remain until the NAT lifecycle has expired.
The NAT lifecycle may be greater than Ts in order to support

15   applications having large timeouts between several data transmissons

When the IP router 13 determines that all the connections to the ports are
unused it sends a message M to the connection controller 11 indicating
that the link to LAN 1 is not in use. The connection controller 11 is

20   responsive to this message to break the connection to the ISP 15
The use of the message therefore circumvents the use of the short term
hold that may be applied by the connection controller 11 and frees the
connection sooner than would otherwise be the case.

25   In an enhancement of the described embodiment, if a terminal reports via
standard TCP protocol features to the IP router 13 that it has been sent
packets which are not required by an application running on the terminal,
then it will trigger the entry z1, z2 or z3 to be set to unused. This will
cater for erroneously sent packets and also packets being sent to a

terminal which has closed down say its internet browsing application when the packets are in transit.

Another enhancement, the router will periodically poll the terminals on
5   the LAN. In the event that a terminal is inactive the unused flag for the corresponding row may be set, resulting in the breaking of the connection if all unused flags are set.

In the described alternative the router initiates the release of the
10 connection via the message M to the connection control. In an other alternative the router periodically tells the connection control when the last usage of any of the NAT entries (row) took place so that the connection control can control the timeout for the release of the PPP link itself.

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Whilst in the described embodiment the network translator, the IP router and the connection controller as shown within one routing unit they may be furnished as separate components. More than connection controller may be provided and they may be embodied in software as software
20 objects.